

CLAIMS

1. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle, comprising:

a master cylinder for generating a brake fluid pressure when a driver steps on a brake pedal;

a check valve interposed between the master cylinder and a wheel brake operable by the brake fluid pressure from the master cylinder for allowing the flow of the brake fluid pressure from the master cylinder to the wheel brake in a braking operation; and,

a normally-open electromagnetic valve closable in order to temporarily maintain the brake fluid pressure of the wheel brake even after removal of the braking operation,

wherein the normally-open electromagnetic valve includes an electromagnetic coil for generating an electromagnetic force when a current is applied thereto, a fixed core to be immovably disposed, and a movable core to be attracted to the fixed core, and

in a brake fluid pressure maintaining state, the normally-open electromagnetic valve is closed due to the electromagnetic force to thereby prevent the return of the brake fluid pressure from the wheel brake to the master cylinder and,

in a brake fluid pressure no-maintaining state, the normally-open electromagnetic valve is always opened to thereby allow the flow of the brake fluid pressure from the master cylinder to the wheel brake or the return of the brake fluid pressure from the wheel brake to the master cylinder, and

wherein the normally-open electromagnetic valve has the following relief function:

by changing the value of the current to be applied to the electromagnetic coil, an attracting force for closing the normally-open electromagnetic valve is changed;

by setting the attracting force at a given value, the brake fluid pressure to be maintained on the wheel brake side is set; and,

when the normally-open electromagnetic valve is closed due to application of a current to the electromagnetic coil, in case where the brake fluid pressure of the wheel

brake is higher than the attracting force of the given value, the normally-open electromagnetic valve is opened against the attracting force to thereby reduce the brake fluid pressure of the wheel brake down to the given value.

2. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 1, wherein the normally-open electromagnetic valve is closed and reduces the brake fluid pressure of the wheel brake down to the given value and, after then, due to decreasing the value of the current to be applied to the electromagnetic coil gradually, reduces the attracting force gradually, thereby reduces the brake fluid pressure of the wheel brake gradually due to the variations in the attracting force.

3. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 2, wherein the normally-open electromagnetic valve decreases the attracting force due to gradually reducing the value of the current to be applied to the electromagnetic coil according to a previously set function.

4. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 1, wherein the normally-open electromagnetic valve is structured such that a recessed portion having a ring-shaped wall surface is formed in one of the mutually attracting surfaces of the fixed core and movable core, a projecting portion to be inserted into the recessed portion is formed in the other, the projecting portion is disposed so as to face the ring-shaped wall surface and, when the movable core is attracted by the fixed core, the projection portion is inserted into the recessed portion and the ring-shaped wall surface is situated on the outer periphery of the projection portion.

5. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 4, wherein the check valve is a cup seal which is disposed on the outer periphery of the normally-open electromagnetic valve not only to separate the master cylinder

side and wheel brake side from each other but also to allow only the flow of the brake fluid pressure from the master cylinder to the wheel brake but prevent the return of the brake fluid pressure from the wheel brake to the master cylinder.

6. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 5, further comprising:

a housing formed as a stepped cylindrical shape including a small-diameter portion and a large-diameter portion, at least a portion of the housing comprising the fixed core;

a cylindrical-shaped valve seat member mounted on and fixed to an interior of a lower end side of the large-diameter portion;

a tapered valve seat disposed on the upper end side of the cylindrical-shaped valve seat member;

a valve hole formed in the axial direction thereof within the tapered valve seat; and

a valve shaft slidable in an axial direction and in contact with the movable core;

a valve chamber formed between the valve shaft and the valve seat member so as to face the valve seat;

an inverted-conical-shaped valve body seated on the tapered valve seat; and

a valve-opening energizing spring energizing the valve shaft in an opposite direction to the valve seat member,

wherein, normally, the valve body is separated from the valve seat and the valve hole is opened due to the pressure energizing force of the valve-opening energizing spring.

7. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 6, further comprising:

a master-side fluid pressure passage communicating with the master cylinder, one fluid pressure chamber;

a wheel-side fluid pressure passage communicating with the wheel brake; and

a plurality of tube-shaped communication passages in the large-diameter portion allowing the one fluid pressure chamber and the valve chamber to communicate with each other,

wherein the master-side fluid pressure passage and valve chamber communicate with each other.

8. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 1, further comprising:

a housing formed as a stepped cylindrical shape including a small-diameter portion and a large-diameter portion; and

a guide tube which is connected and fixed to an upper end of the fixed core to guide the movable core with respect to the fixed core, wherein

the fixed core is disposed on an upper end of the small-diameter portion,

the movable core is contacted with an upper end of a valve shaft to press and move the valve shaft in a valve closing direction,

the movable core is formed in a cylindrical shape and is disposed so as to be contactable with the upper end of the valve shaft, and

when the normally-open electromagnetic valve is not in operation, due to a pressure energizing force of a valve-opening energizing spring mounted in a valve chamber, the movable core is energized through the valve shaft in the direction where it is moved apart from the fixed core.

9. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 1, further comprising recessed one or more flow grooves in an axial direction in each of an outer peripheral surface of the movable core and a valve shaft contactable with the movable core, wherein

the one or more grooves allow the brake fluid to flow freely between a housing and guide tube housing the movable core,

the one or more grooves prevent a generation of the pressure difference between an interior of the housing and a guide tube housing the movable core, thereby permitting

the smooth movement of the movable core and a valve shaft moving with the movable core.

10. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 9, further comprising a recessed portion forming a ring shaped surface in the fixed core and a cylindrical ring shaped projecting surface in the movable core which is disposed to face the recessed portion of the fixed core, wherein in a state where the fixed core and movable core are most distant from each other with no attracting force applied therebetween, a leading end of the cylindrical ring shaped projecting surface is slightly inserted into the recessed portion.

11. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 6, wherein:

when the brake fluid pressure is not maintained, the normally-open electromagnetic valve is deenergized and no attracting force is generated between the fixed core and the movable core; and

due to the pressure energizing force of the valve opening energizing spring mounted in contact with the valve shaft and within the valve chamber the movable core is pressed and energized in a parting direction from the fixed core through the valve shaft and, at a same time, the valve body is separated from the valve seat to thereby open the valve hole, so that the normally-open electromagnetic valve is held open.

12. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 6, wherein:

when the brake fluid pressure is maintained, in case where a current is applied, there is generated an attracting force which moves the movable core in an approaching direction to the fixed core; and

the attracting force is set so as to exceed the energizing force of the valve opening energizing spring which is used to press and energize the valve body in the valve opening direction.

13. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 12, wherein:

where the movable core is moved in the approaching direction to the fixed core due to the attracting force against the energizing force of the valve opening energizing spring, the valve body is seated on the valve seat through the valve shaft to thereby close the valve hole, so that the normally-open electromagnetic valve is closed.

14. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle, comprising:

a master cylinder;

a check valve interposed between the master cylinder and a wheel brake; and

means for reducing a fluid pressure of the wheel brake by adjusting an attracting force between a movable core and a fixed core when the brake fluid pressure of the wheel brake is higher than an attracting force of a given value.

15. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 14, wherein the means for reducing a pressure is provided gradually such that the attracting force is gradually reduced.

16. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 14, wherein the means for reducing a pressure includes a current applied to a normally-open electromagnetic valve to close the normally-open electromagnetic valve and reduce the brake fluid pressure of the wheel brake down to the given value and, after then, due to decreasing the value of the current to be applied to the electromagnetic coil gradually, reduce the

attracting force gradually and thus reduce the brake fluid pressure of the wheel brake gradually due to variations in the attracting force.

17. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 14, further comprising a means for increasing the attracting force between the fixed core and the movable core.

18. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 17, wherein the increasing means includes a projection fitting within a recess of the movable and the fixed core.

19. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle as set forth in Claim 14, further comprising a means for preventing a pressure difference from being generated between an interior of the housing and guide tube due to movement of the movable core.

20. (previously presented) A brake fluid pressure maintaining apparatus for a vehicle, comprising:

a check valve interposed between a master cylinder and a wheel brake; and
means for adjusting a brake fluid pressure in the wheel brake on an ascending or descending slope by adjusting a current to an electromagnetic valve disposed between a movable core and a fixed core to increase or decrease an attracting force between the movable core and the fixed core,

wherein after the brake fluid pressure of the wheel brake is lowered to a given value under the control of the adjusting means, a value of the current applied to the electromagnetic valve is lowered to reduce the attracting force acting on the movable core, the brake fluid pressure of the wheel brake becomes higher than the attracting force that can close the electromagnetic valve, and the high brake fluid pressure of the wheel brake acts on a seal surface

so that a valve body is separated from a valve seat of the seal surface against the attracting force to thereby open a valve hole so that the electromagnetic valve is opened and in the opened state, the fluid pressure of the wheel brake is returned through the valve hole to the master cylinder to lower the fluid pressure of the wheel brake above the given value.